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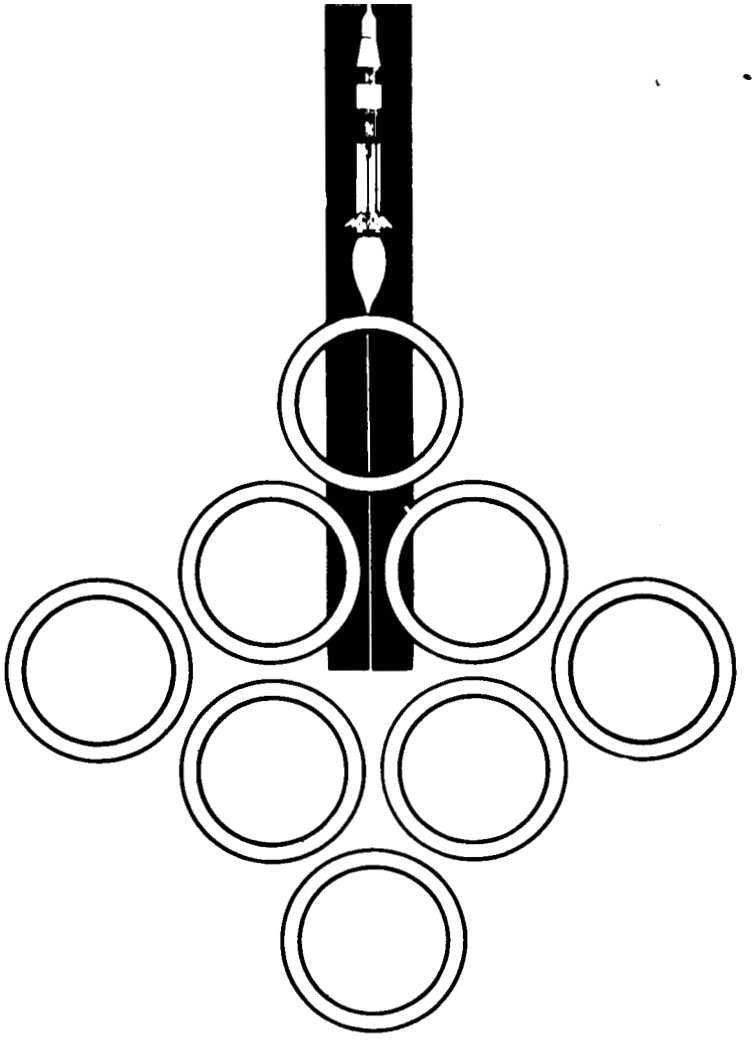

ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1113-3

February 3, 1967

SATURN IB PROGRAM

TEST REPORT
FOR

COMPOUND PRESSURE AND VACUUM RELIEF VALVE, 2-INCH

Ladewig Valve Company Part Number 3302

NASA Drawing Number 75M04406 PRV-2

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

COMPOUND PRESSURE AND VACUUM RELIEF VALVE, 2-INCH

Ladewig Valve Company Part Number 3302

NASA Drawing Number 75M04406 PRV-2

ABSTRACT

This report presents the results of tests performed on one specimen of the Compound Pressure and Vacuum Relief Valve 75M04406 PRV-2. The following tests were performed:

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Low Temperature
5. High Temperature
6. Salt Fog

The vacuum relief valve did not meet the requirements of minimum cracking pressures of 0.5 ounces per square inch for pressure and vacuum relief. The cracking pressure is not adjustable. The vacuum relief valve deteriorated in the salt fog environment and failed to function.

TEST REPORT

FOR

COMPOUND PRESSURE AND VACUUM RELIEF VALVE, 2-INCH

Ladewig Valve Company Part Number 3302

NASA Drawing Number 75M04406 PRV-2

February 3, 1967

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

3200-3-8-67

FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-4016, Part VII, CWO 271620.

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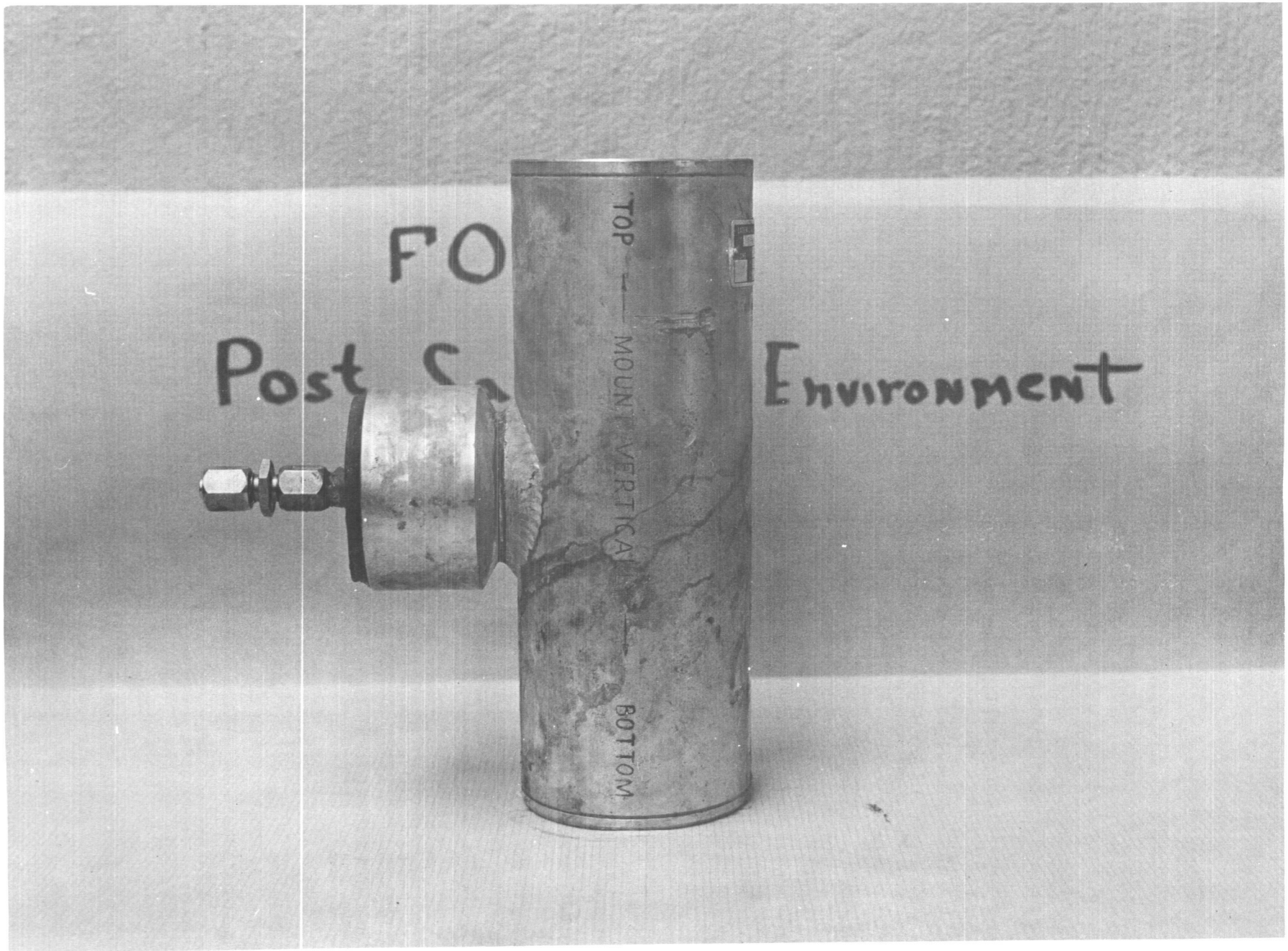

Compound Pressure and Vacuum Relief Valve, 2-Inch

CHECK SHEET

FOR

COMPOUND PRESSURE AND VACUUM RELIEF VALVE, 2-INCH

MANUFACTURER: Ladewig Valve Company
MANUFACTURER'S PART NUMBER: 3302
MANUFACTURER'S DRAWING NUMBER: N279
NASA DRAWING NUMBER: 75M04406 PRV-2
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	Air or GN_2
B.	OPERATING PRESSURE:	Static, $\frac{1}{2}$-oz/in.^{2} differential
C.	VALVE LEAKAGE:	Internal - None External - None
D.	VALVE OPERATION:	Dead Weight Poppet

II. CONSTRUCTION

A.	MATERIAL:	Body - Steel castings Valves - Aluminum Screen - Stainless steel
B.	CONNECTIONS:	2-inch FNPT

III. ENVIRONMENTAL REQUIREMENTS

A.	OPERATING TEMPERATURE:	+5°F to +125°F

IV. LOCATION AND USE: Used in the environmental control system at John F. Kennedy Space Center Launch Complexes 34 and 37B.

TEST SUMMARY

COMPOUND PRESSURE AND VACUUM RELIEF VALVE

75K04406 PRV-2

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Receiving Inspection	1	Visual Examination	To determine if the specimen conformed with 75K04406 PRV-2	Satisfactory	Vendor Drawing N 279
Functional Test Pressure	1	0.5 oz/in.^{2}	Determine cracking and reseating pressure Check for leakage	Unsatisfactory	Cracking pressure 0.85 oz/in.^{2} Reseating pressure 0.82 oz/in.^{2}
Vacuum	1	0.5 oz/in.^{2}	Determine Cracking and reseating vacuum. Check for seat leakage.	Unsatisfactory	Cracking pressure 0.88 oz/in.^{2} Reseating pressure 0.83 oz/in.^{2}
Low Temperature Test	1	5°F	Determine the effect of low temperature on the specimen	Satisfactory	
High Temperature Test	1	125°F	Determine if specimen operation is impaired by high temperature.	Satisfactory	
Salt Fog Test	1	5% solution for 240 hours	Determine if specimen operation is impaired by exposure to salt fog.	Failed to function after exposure.	Cracking 75 PSIG valve failed to function, could not be repaired.

TEST SUMMARY

COMPOUND PRESSURE AND VACUUM RELIEF VALVE

75M04406 PRV-2

Environment	Units	Operational Boundary	Test Objective	Test Results	Remarks
Cycle Test	0	500 cycles	Determine if specimen operation is impaired by cycling.	Not conducted	Specimen failed prior to testing.
Burst Test	0	125 psig	Minimum burst pressure	Not conducted	Specimen failed prior to testing.

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests that were performed to determine if relief valve 75M04406 PRV-2 meets the operational requirements for John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on page viii.

1.2 ITEM DESCRIPTION

Relief valve 75M04406 PRV-2 is a 2-inch valve with 2-inch FNPT connections, and is used on the water/glycol expansion piping in the environmental control system. The valve is a deadweight poppet design and is actuated by a differential pressure. The valve is capable of venting through either the inlet or outlet ports.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for valve 75M04406 PRV-2:

a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.

b. NASA Drawing 75M04406 PRV-2

c. MSFC-SPEC-164(D), Cleanliness Standard

d. Test Plan CCSD-FO-1113-1F

e. Test Procedure TP-RE-CCSD-FO-1113-2F

SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

The specimen shall be visually and dimensionally inspected for conformance with the applicable specifications prior to testing.

2.2 TEST PROCEDURE

A visual and dimensional inspection of the specimen was performed to determine compliance with NASA Drawing 75M04406 PRV-2 and the applicable vendor drawing to the extent possible without disassembly of the test specimen. At the same time, the specimen was also inspected for poor workmanship and manufacturing defects.

2.3 TEST RESULTS

The specimen complied with NASA Drawing 75M04406 PRV-2 and vendor drawing N279. No evidence of poor workmanship or manufacturing defects were observed.

2.4 TEST DATA

The data presented in tables 2-1 and 2-2 were recorded during the inspection.

Table 2-1. Specimen Nomenclature

NAME	Compound Pressure and Vacuum Relief Valve
PART NO.	3302
SERIAL NO.	14565

Table 2-2. Specimen Dimensions

SIZE	2-Inch
END CONNECTION	2-Inch FPT

SECTION III

FUNCTIONAL TEST

3.1 TEST REQUIREMENTS

The test specimen shall be subjected to an operational pressure and vacuum test, a cracking pressure test, and a cracking vacuum test. Air or GN_2 shall be used as the test medium for all functional tests.

3.2 TEST PROCEDURE

3.2.1 OPERATIONAL PRESSURE TEST

3.2.1.1 The test setup was assembled as shown in figure 3-1, using the equipment listed in table 3-1.

3.2.1.2 All connections were tightened and no leakage was observed.

3.2.1.3 All valves were closed.

3.2.1.4 GN_2 pressure source 2, the inlet port of control valve 8 was pressurized to 10 psig by adjusting regulator 6. The pressure was monitored on gage 7.

3.2.1.5 Control valve 11 was opened and control valve 8 was cracked. Control valve 11 was slowly closed and the inlet port of the specimen was pressurized until the cracking pressure had been exceeded.

3.2.1.6 Control valve 11 was slowly opened and the pressure poppet was allowed to reseat. Control valves 8 and 11 were closed.

3.2.1.7 The specimen was cycled several times (paragraphs 3.2.1.4, 3.2.1.5, and 3.2.1.6) to ensure that the specimen was operating properly.

3.2.1.8 The inlet port of control valve was pressurized by adjusting regulator 6 and monitoring gage 7. Control valve 11 was opened. Control valve 9 was opened slowly and the inlet port of the specimen was depressurized until the vacuum cracking pressure had been exceeded.

3.2.1.9 Control valve 9 was slowly closed and the vacuum poppet was allowed to reseat. Control valve 11 was closed.

3.2.1.10 The test specimen was cycled several times (paragraphs 3.2.1.8 and 3.2.1.9) to ensure that the specimen was operating properly.

3.2.2 CRACKING PRESSURE TEST

3.2.2.1 The inlet port of control valve 8 was pressurized to 10 psig by adjusting regulator 6 and monitoring the pressure on gage 7.

3.2.2.2 Reservoir 13 was filled with water.

3.2.2.3 Control valve 11 was opened and control valve 8 was cracked. Control valve 11 was slowly closed and the inlet port of the specimen was pressurized to 95 per cent of the cracking pressure. The pressure was monitored by means of manometer 12.

3.2.2.4 The specimen was checked for external and internal leakage. External leakage was checked by performing a soap test; internal leakage was checked by observing reservoir 13 for the presence of bubbles.

3.2.2.5 Control valve 11 was slowly closed until the specimen opened. The pressure was monitored by means of manometer 12, and the cracking pressure was recorded.

3.2.2.6 Control valve 11 was slowly opened and the inlet port of the specimen was depressurized to zero psig. The pressure was monitored by means of manometer 12, and the reseating pressure was recorded. Control valve 8 was closed.

3.2.2.7 The specimen was checked for external and internal leakage at pressures below the reseating pressure. External leakage was checked by performing a soap test and internal leakage was by monitoring tube 14 for a rise in water level.

3.2.3 CRACKING VACUUM TEST

3.2.3.1 The inlet port of control valve 9 was pressurized by adjusting regulator 6 and monitoring the pressure on gage 7. Control valve 11 was opened.

3.2.3.2 Control valve 9 was slowly opened and the inlet port of the specimen was depressurized to 95 per cent of the cracking vacuum. The vacuum was monitored by means of manometer 12. Control valve 11 was closed.

3.2.3.3 The specimen was checked for internal and external leakage. External leakage was checked by monitoring manometer 12 for an decrease in vacuum at the specimen. Internal leakage was checked by observing tube 14 for a rise in the water level.

3.2.3.4 Control valve 11 was opened. Control valve 9 was slowly opened until the specimen opened. The vacuum was monitored by means of manometer 12 and the cracking vacuum was recorded.

3.2.3.5 Control valve 9 was closed and the specimen was pressurized to zero psig. The vacuum was monitored by means of manometer 12 and the reseating vacuum was recorded.

3.2.3.6 The specimen was shecked for external and internal leakage at vacuum below reseating vacuum. External leakage was checked by performing a soap test, and internal leakage was checked by monitoring tube 14 for a decrease in water level.

3.2.3.7 Regulator 6 was closed and the system was vented by opening control valve 9.

3.2.3.8 The tests described in 3.2.3.2 through 3.2.3.6 were performed as often as necessary to obtain consistent results.

3.3 TEST RESULTS

The test specimen was found to crack and reseat above the 0.5 ounces per square inch required. The specimen operated on the fixed weight of the poppets and cannot be adjusted without modifying the poppets.

3.4 TEST DATA

Test data recorded during the initial functional test is presented in table 3-2.

Table 3-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Ladewig Valve Company	3302	14565	2-inch pressure-vacuum relief valve
2	GN_2 or Air Source	CCSD	NA	NA	0 to 500 psig
3	Pressure Gage	Ashcroft	10575	NA	0 to 3000 psig 1% FS accuracy cal. date: 11/3/66
4	Filter	Bendix Corp.	2-S 13460 -16-B-C	58	2-Micron
5	Pressure Gage	Ashcroft	NA	08-1113	0-to 1000 psig 1% FS accuracy cal. date: 11/3/66
6	Pressure Regulator	Tescom Corp.	26-1003	1008	0 to 3000 psig inlet 0 to 500 psig outlet
7	Pressure Gage	Heise	NA	015532	0 to 500 psig 0.1% FS accuracy Cal. date: 10/16/66
8	Control Valve	Robbin Aviation	SSKG-250-4T	NA	½-inch, flow regulating
9	Control Valve	Robbin Aviation	SSKG-250-4T	NA	½-inch, flow regulating
10	Aspirator	CCSD			
11	Control Valve	Robbin Aviation	SSKG-250-4T	NA	½-inch, flow regulating
12	Manometer	King Engineering Corporation	NA	012572	H_2O cal. date: 4/1/66
13	Reservoir	CCSD			H_2O

Table 3-1. Functional Test Equipment List (Continued)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
14	Clear Tube	Tygon Products	R3603	NA	$\frac{1}{4}$-inch

Table 3-2. Functional Test Data

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.83	0.75	0.87	0.81
2	0.86	0.83	1.21	1.20
3	0.86	0.85	0.88	0.82
4	0.84	0.83	0.65	0.61
5	0.84	0.83	0.82	0.73
Avg.	0.85	0.82	0.89	0.83

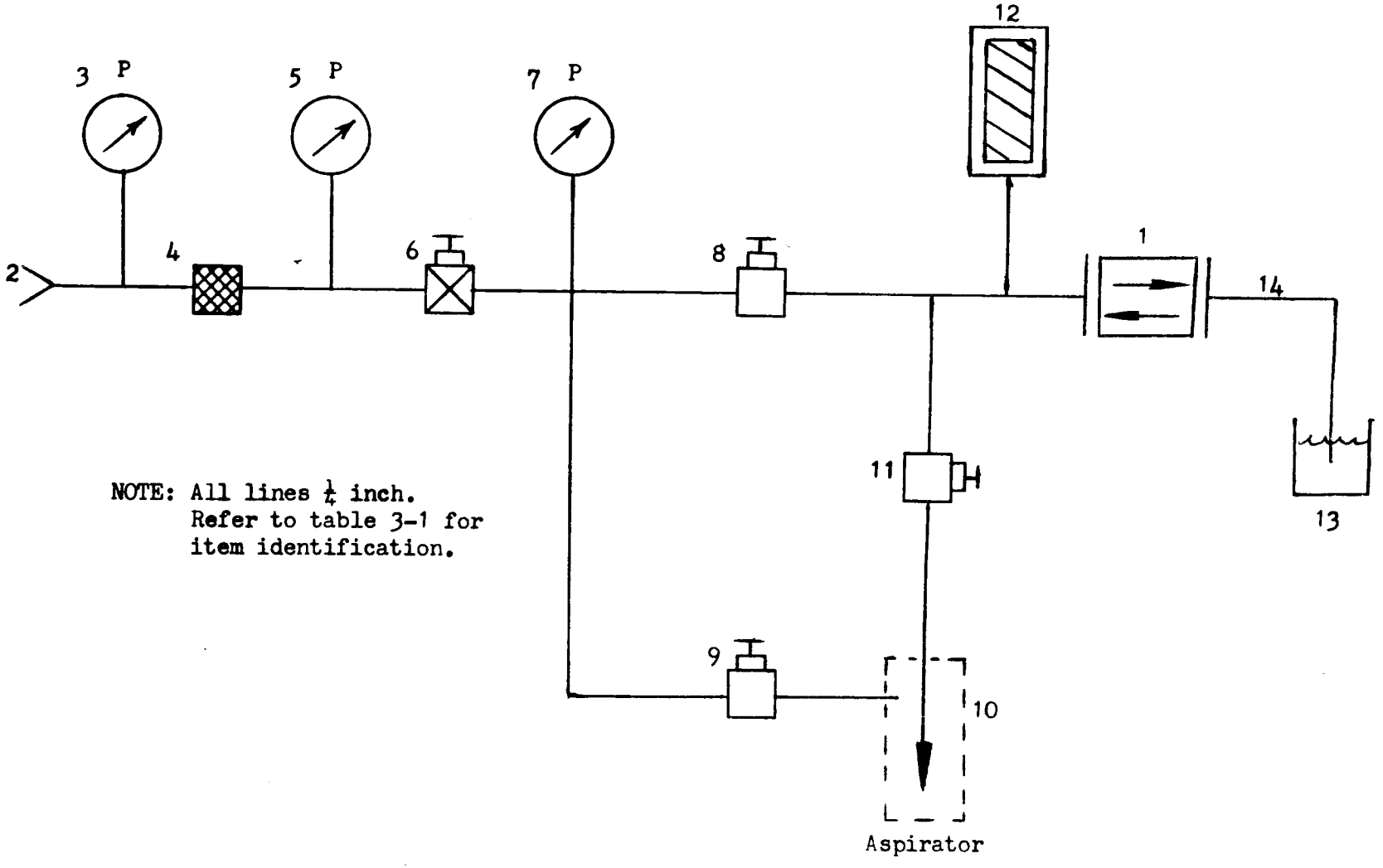

Figure 3-1. Functional, Low Temperature, and High Temperature Test Schematic

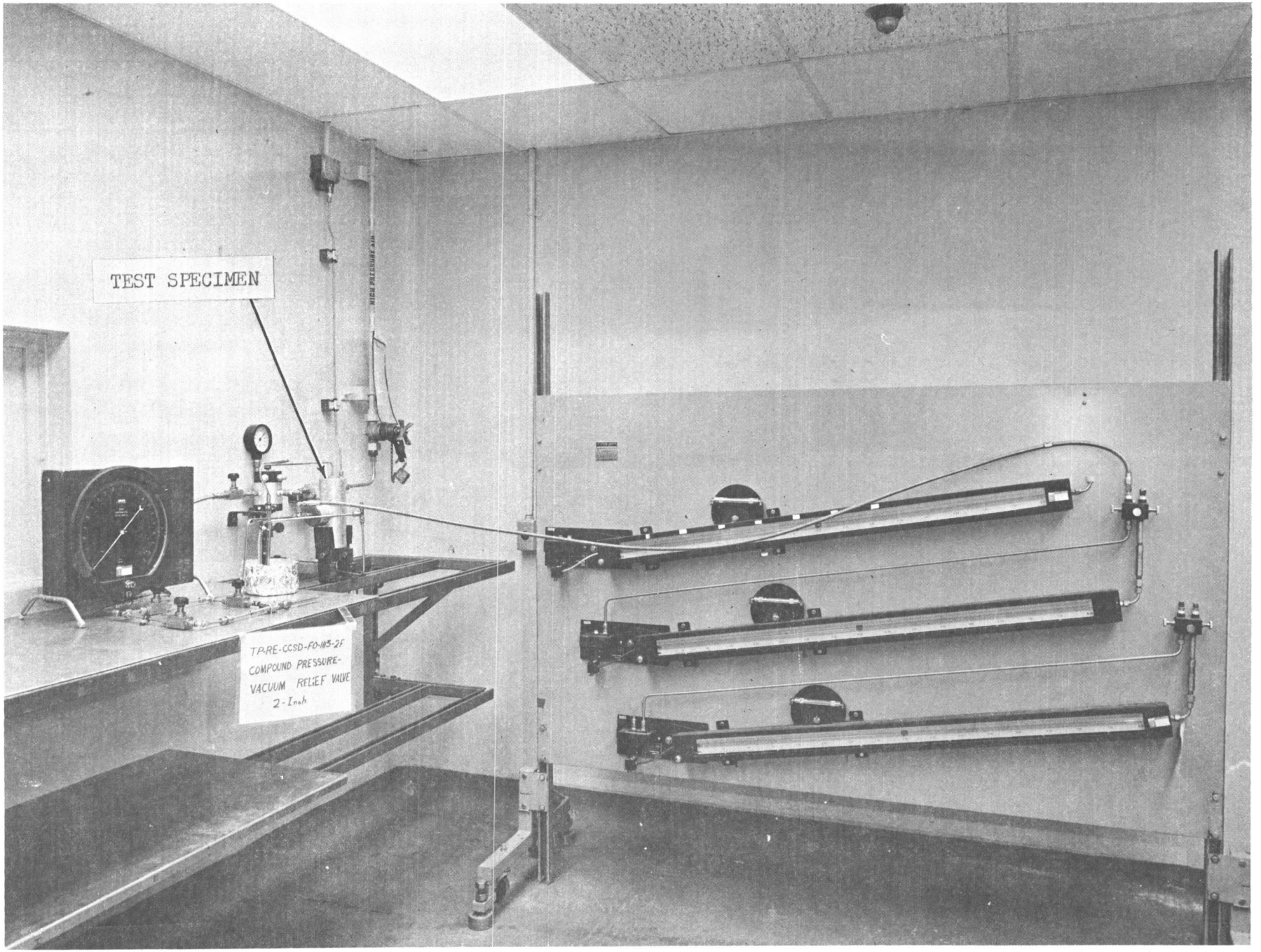

Figure 3-2. Functional Test Setup

SECTION IV

LOW TEMPERATURE TEST

4.1 TEST REQUIREMENTS

4.1.1 A low temperature test will be performed on the test specimen to determine whether the environment causes degradation or deformation.

4.1.2 The rated low temperature is 5°F (+0, -4°F).

4.1.3 A functional test shall be performed during this test. The specimen will not be submerged in water. Specimen leakage will be monitored by noting pressure drop.

4.2 TEST PROCEDURE

4.2.1 The specimen was placed in a low temperature chamber and was installed in a test setup as shown in figure 3-1.

4.2.2 The chamber was controlled to the specified test conditions.

4.2.3 A functional test was performed when the temperature of the specimen has stabilized.

4.2.4 The chamber temperature was returned to ambient conditions upon completion of the functional test.

4.2.5 The specimen was visually inspected and functionally tested within one hour following its return to ambient conditions.

4.3 TEST RESULTS

Results of the low temperature test and functional tests were satisfactory.

4.4 TEST DATA

Test data recorded before, during and after the tests are presented in tables 4-2, 4-3, and 4-4, respectively.

Table 4-1. Low Temperature Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Ladewig Valve Company	3302	14565	2-inch pressure-vacuum relief valve
2	Temperature Chamber	CCSD	NA	NA	As specified in KSC-STD-164(D)
3	Functional Test Equipment		NA	NA	Same equipment as used in table 3-1
4	Thermotron	Thermotron Corp.	NA	106.200 507. T	-100 to +400 cal. date: 9/6/66

Table 4-2. Function Test Data Obtained Before Low Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.90	0.65	0.64	0.61
2	0.87	0.78	0.75	0.71
3	0.84	0.64		
Avg.	0.87	0.69	0.70	0.66

Table 4-3. Functional Test Data Obtained During Low Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.78	0.72	0.75	0.70
2	0.75	0.66	0.78	0.73
3	0.78	0.67		
Avg.	0.76	0.68	0.77	0.72

Table 4-4. Functional Test Data Obtained After Low Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.90	0.76	0.75	0.64
2	0.87	0.76	0.79	0.62
3	0.87	0.72	0.88	0.65
4			0.89	0.62
5			0.78	0.65
Avg.	0.88	0.75	0.82	0.65

Figure 4-1. Low Temperature Test Setup

SECTION V

HIGH TEMPERATURE TEST

5.1 TEST REQUIREMENTS

5.1.1 A high temperature test will be performed on the test specimen to determine whether the environment causes degradation or deformation.

5.1.2 The rated high temperature is 125°F (+4, -0°F).

5.1.3 A functional test shall be performed during this test.

5.2 TEST PROCEDURE

5.2.1 The test specimen was installed in a high temperature chamber as shown in figure 3-1.

5.2.2 The chamber was controlled to the specified test conditions of 125°F (+4, -0°F) and this temperature was maintained for 72 hours (+2, -0 hours).

5.2.3 A functional test was conducted while the chamber temperature was maintained.

5.2.4 The chamber temperature was returned to ambient conditions upon completion of the high temperature test.

5.2.5 The specimen was visually inspected and functionally tested within 1 hour following its return to ambient conditions.

5.3 TEST RESULTS

Results of the high temperature test and associated functional tests were satisfactory.

5.4 TEST DATA

Test data recorded before, during, and after the high temperature test are presented in tables 5-2, 5-3, and 5-4, respectively.

Table 5-1. High Temperature Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Ladewig Valve Company	3302-	14565	2-inch pressure relief valve
2	High Temperature Chamber	Conrad	NA	200494-1	-125°F +525°F As specified in KSC-STD-164(D) Cal. Date: 10/20/66
3	Functional Test Equipment		NA	NA	Same equipment as used in table 3-1.

Table 5-2. Functional Test Data Obtained Before High Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.70	0.65	0.88	0.80
2	0.72	0.64	0.76	0.70
Avg	0.71	0.65	0.82	0.75

Table 5-3. Functional Test Data Obtained During High Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.87	0.86	0.74	0.68
2	1.60	1.26	0.76	0.68
3			0.72	0.70
4			0.75	0.70
5			0.76	0.68
6			0.76	0.74
Avg	1.24	1.03	0.76	0.70

Table 5-4. Functional Test Data Obtained After High Temperature Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	0.96	0.92	0.96	0.86
2	0.98	0.64	0.96	0.86
Avg	0.97	0.78	0.96	0.86

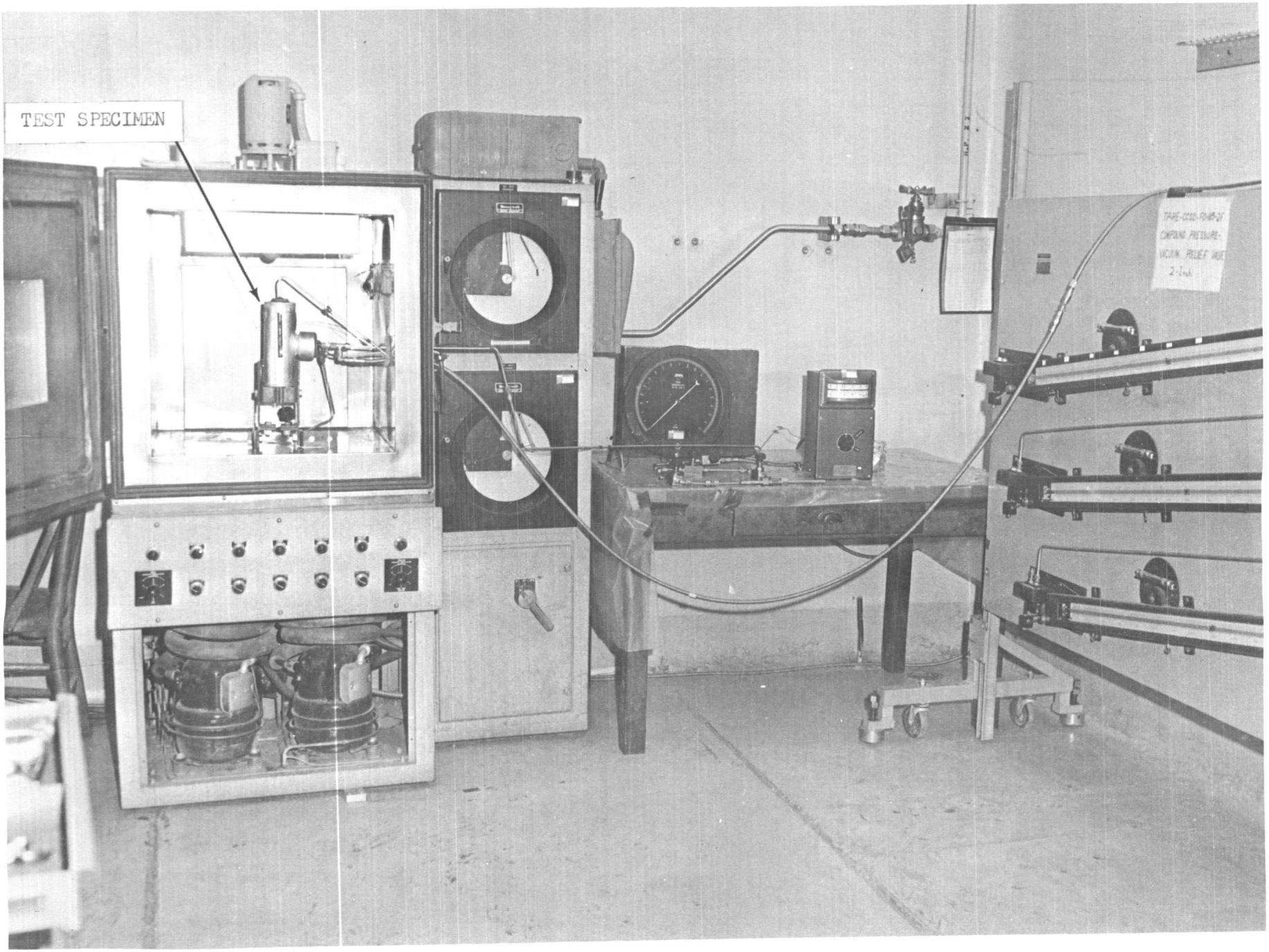

Figure 5-1. High Temperature Test Setup

SECTION VII

SALT FOG TEST

6.1 TEST REQUIREMENTS

6.1.1 The salt fog test shall be performed to determine the resistance of the test specimen to a salt atmosphere.

6.1.2 The salt fog test shall be performed in accordance with KSC-STD-164(D), section 17.

6.1.3 The specimen shall be exposed to the salt fog for 240 (±2) hours. The inlet port, only, of the specimen shall be capped during exposure to the salt atmosphere.

6.1.4 A functional test shall be performed upon completion of the salt fog test.

6.2 TEST PROCEDURE

6.2.1 The specimen was visually inspected for corrosion, dirt, and oily films. All oily films, other than those required for normal service usage, and dirt particles were removed. The specimen was placed in the salt fog chamber listed in table 6-1.

6.2.2 The temperature in the exposure zone was maintained at 95°F. The salt fog conditions in the exposure zone were maintained such that a clean fog-collecting receptacle placed at any point in the exposure zone would collect from 0.5 to 3 milliliters of salt solution per hour for each 80 square centimeters of horizontal collecting area (10 centimeters diameter), based on an average test of at least 16 hours. The salt solution consisted of five parts by weight of sodium chloride and 95 parts by weight of H_2O.

6.2.3 The specimen was exposed to the salt fog conditions for 240 hours.

6.2.4 Upon completion of the exposure test, the specimen was removed from the chamber and salt deposits removed from the specimen to the extent necessary to make mechanical connections. A functional test, as specified in section IV, was performed within 1 hour (see figure 6-1).

6.2.5 All data were recorded.

6.3 TEST RESULTS

The test specimen failed to operate properly after exposure to the salt fog environment (see figure 6-2). During the functional test, after the 240-hour salt fog test, the cracking pressure was 75 psig. The test procedure specifies 0.5 ounces per square inch as the cracking pressure. After cracking pressure was reached the valve failed to reseat and stuck in a relieved position. An examination showed that corrosion of the pressure valve and valve seat was the cause of the difficulty.

The specimen deteriorated to the extent to prevent further testing.

6.4 TEST DATA

The data presented in table 6-2 were recorded during the test.

Table 6-1. Salt Fog Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Ladewig Valve Company	3302	14565	Pressure-vacuum relief valve, 2-inch
2	Salt Fog Chamber	Industrial Filter and Pump Manufacturing Co.	411.1C	S-3632	As specified in KSC-STD-164(D)

Table 6-2. Functional Test Data Obtained After Salt Fog Test

Trial Number	Pressure		Vacuum	
	Cracking (oz/in^2)	Reseating (oz/in^2)	Cracking (oz/in^2)	Reseating (oz/in^2)
1	75 psig	would not reseat		

Figure 6-1. Failed Specimen After Exposure to Salt Fog

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